# A simple technique to achieve bloodless excision of carotid body tumors

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**We describe a technique for Shamblin II-III carotid body tumor (CBT) resection to reduce bleeding and neurologic complications during surgery. The technique was based on the fact that CBTs are supplied almost exclusively from the external carotid artery. Therefore, we carefully isolated the origin of the external carotid artery and its distal branches outside the tumor and temporarily clamped all of these vessels after heparin administration. This allowed a safe and bloodless resection as the tumor was dissected from the internal carotid artery in the usual subadventitial plane. The internal carotid artery was never clamped, and respect of peripheral nerves was warranted in the clean and bloodless field. From 2007 to 2010, we treated 11 patients with a CBT: six had a Shamblin II and five had a Shamblin III lesion. Neither perioperative neurologic events nor recurrences occurred after a mean follow-up of 42 months. (J Vasc Surg 2014;59:1462-4.)**

Carotid body tumors (CBTs) account for only 0.5% of all body tumors but represent 60% to 70% of head and neck paraganglioma.[1] These lesions develop from mesodermal elements of the third branchial arch and neural elements originating from the neural crest. They are innervated by the glossopharyngeal and vagus nerves and are supplied by a tangle of vessels running from the ascending pharyngeal artery and from the external carotid artery (ECA) and its anterior branches. We present a simple technique to allow a safe and bloodless resection of CBTs without any previous preparation that was used in 11 patients who underwent complete surgical resection in our institution.

## TECHNIQUE

Our technique is based on the fact that CBTs are supplied almost exclusively from the ECA and its branches, whereas the internal carotid artery (ICA) contribution is extremely rare and marginal, and no feeding branches arise from the common carotid artery (CCA). Therefore, by clamping the ECA at its origin, flush to the CCA, we blocked all of the anterograde blood supply to the mass. By clamping the superior thyroid, lingual, facial, distal ECA, and ascending pharyngeal arteries distal to the tumor, we prevented retrograde bleeding. These vessels were easily prepared in the unaffected field anteriorly to the CBT, also when it encompassed the ECA and even the ICA. A bloodless field allowed safe and thorough resection, with respect of peripheral nerves, carefully dissected with the help of bipolar coagulation, while the flow into the ICA was never disturbed.

The surgical technique started by CCA exposure proximal to the bifurcation. In very large lesions (≥8 cm), small vessels arising from the CCA were occasionally encountered and easily treated by bipolar coagulation. A bloodless plane was followed by surrounding the mass, starting from the posterior aspect of the CCA and going cranially until the proximal pole of the tumor. This can be situated high but is usually within the inferior border of the posterior belly of the digastricus muscle, behind the mandible. By a careful dissection, we could avoid injury of the hypoglossal and glossopharyngeal nerves (Fig 1). Once the preparation of the posterior border of the mass was completed, a similar dissection was done on the anterior border of the ECA, starting from the CCA and going up.

All of the anterior branches of the ECA were progressively encountered and looped, starting from the superior thyroid up to the lingual and facial. By continuing cranially, the outflow branches of the ECA were encountered and prepared on the cranial aspect of the mass. At the end of this phase, the mass was thus surrounded en-bloc within the carotid bifurcation, and the ECA and all of its anterior branches had been dissected distally.

In the next step, the origin of the ECA was prepared flush to the ICA by working out the subadventitial plane with the help of bipolar coagulation, gaining just enough space to place a thin occluder clamp (Fig 2). At this moment, intravenous heparin was given at the dose of 70 IU/kg, and the ECA was double-clamped at its origin and distal to the mass, while all of the loops were tied against the anterior branches. In some large cases, the proximal clamp had been posed so close to the ICA that its adventitia was involved on the anterior aspect of the vessel, without interfering with the flow into the ICA because the vessels were large and free of disease.

If the cranial aspect of the lesion reached the inferior border of the digastricus, we anticipated the proximal

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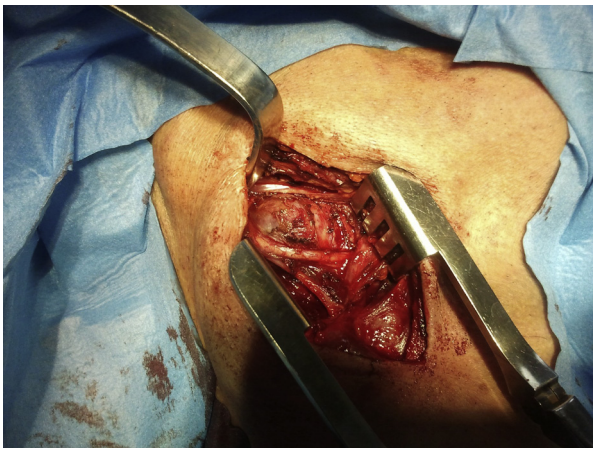

**Fig 1.** Careful dissection is done to avoid injury of the hypoglossus and glossopharyngeal nerves.

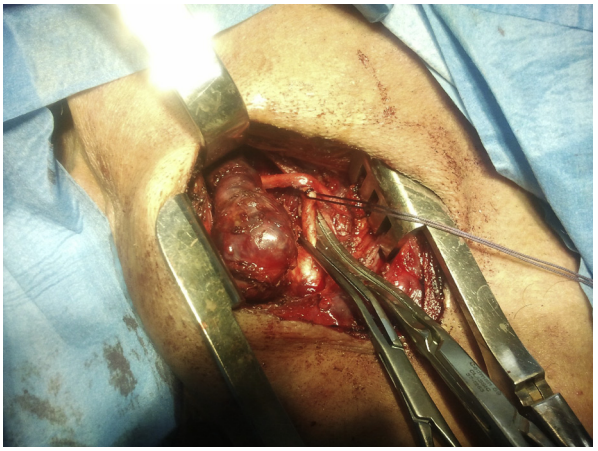

**Fig 2.** The origin of the external carotid artery (ECA) is prepared to place a thin occluder clamp.

ECA clamping so that the mass became softer. This allowed a gentle downward traction on the upper pole by the assistant so that the mass could be isolated and the major ECA branches could be eventually reached and looped, even in a deep position. By doing so, mandibular subluxation and nasotracheal intubation were never necessary.

The subsequent dissection was done in a subadventitial plane by freeing the mass from the ICA, as described by Gordon-Taylor.[2] Bipolar coagulation has been useful to work out the correct plane and to minimize oozing. Once detached from the ICA, the mass was progressively freed on its posterior aspect and from the ECA by coagulating and ligating all of the feeding branches arising from the posterior aspect of the vessel (Figs 3 and 4). Occasional thin vessels feeding the mass from the posterior aspect were easily managed by bipolar coagulation.

From January 2007 to December 2010, we treated 11 patients with CBTs, comprising six Shamblin II lesions

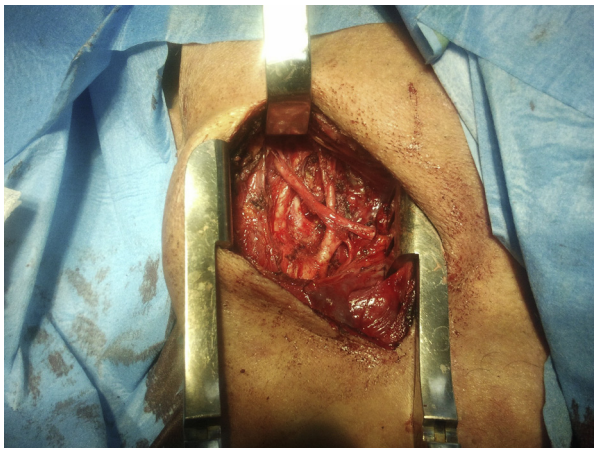

**Fig 3.** The carotid bifurcation is free of tumor.


**Fig 4.** Carotid body tumor (CBT).

intimately associated with the carotid vessels and five Shamblin III tumors that involved the carotid vessels. The size of lesions ranged from 4 to 9 cm and were >6 cm in eight patients. No patient received a blood transfusion. A complete CBT excision was achieved in all cases. No modifications of brain perfusion during ECA clamping were observed. During a middle-term follow-up of 42 months, no vagus nerve injuries were recorded. Only two patients (18%) with temporary hypoglossal nerve dysfunction, with spontaneous resolution 4 months later, were observed after Shamblin III CBT resection.

## DISCUSSION

Complete surgical excision of CBT is currently considered the most efficient modality of treatment.[3] It should be performed soon after diagnosis because of the potential of the tumor to be malignant and the technical difficulty to achieve radical excision of large lesions.[3,4] In particular, during resection of large CBTs adherent to carotid vessels (Shamblin II-III), injury to cranial nerves

VII, IX, X, XI, and XII may occur.[5] Cerebral ischemia, occasionally reported as a complication of ICA manipulation, is extremely rare and has occurred only once in the 131 patients of the Mayo Clinic series.[6]

To reduce the percentage of neurologic complications, some authors have suggested preoperative ECA embolization performed ≤48 hours before the operation to reduce tumor size and blood loss and improve visibility.[7] Although safe and effective in experienced hands, this is an invasive and potentially harmful procedure, and occasional complications have been reported.[8] Moreover, others have reported that ECA embolization did not prevent excessive bleeding or neurologic complications in all cases.[9]

The advantage of our technique is to reduce invasiveness and costs. It also enables the surgeon to be the only master of intraoperative bleeding that he or she can easily control without adjuncts. Preoperative embolization has never been necessary since we have begun using this technique.

An additional problem with Shamblin III tumors arises when the ICA and ECA are both encompassed within the mass. Such lesions have occasionally been treated by vessel resection and graft replacement. Three of our Shamblin III tumors included the entire ECA and the initial portion of the ICA for >25 mm. The isolation of the ECA origin was particularly difficult because the tumor surrounded the last 3 to 5 mm of the CCA. After careful dissection, we clamped the ECA flush to the CCA, and the branches of the ECA distal to the artery were dissected in the free-of-disease surrounding tissue. The cranial border of large CBTs was the most difficult part to dissect, because small feeding vessels were arising from the distal ascending pharyngeal artery, and the hypoglossal, glossopharyngeal, and superior laryngeal nerves were partly included in the mass, its Schwann sheath being attained by small vessels, although the fibers were intact.

By using our "double-clamping" technique, we could control the gentle oozing from the nerve sheath using bipolar coagulation. The two instances of temporary hypoglossal nerve dysfunctions were due to sheath abrasion, but the fiber had been left intact. In addition, we could free the ICA and the ECA surrounded by the tumor: after double-clamping the ECA and its branches distal to the mass, we entered the mass from its posterior aspect in a vertical plane sagittal to the posterior aspect of the ICA, starting from below. This plane was almost bloodless because the vessels were coming backward from the two sides of the ICA, and very few vessels were crossing on its posterior aspect. Once the subadventitial plane of the vessel was attained, we could complete the dissection in the usual way. The ECA was isolated starting from below, and the larger feeding vessels were tied as needed with a 6-0 polypropylene suture flush to the ECA.

## CONCLUSIONS

We have been gratified by the lack of operative mortality and permanent neurologic complications. The absence of recurrences during a middle-term follow-up of 42 months enables us to believe that the excision was radical in all patients.

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